ZooKeys 23: 47–75 (2009)
doi: 10.3897/zookeys.23.248
www.pensoftonline.net/zookeys

RESEARCH ARTICLE

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Revision of the bee genus *Chlerogella* (Hymenoptera, Halictidae), Part I: Central American species

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Academic editor: *Michael Ohl* | Received 15 August 2009 | Accepted 25 September 2009 | Published 06 October 2009

urn:lsid:zoobank.org:pub:B8BF67EF-769B-482A-8EEB-77722F80EB94

Citation: Engel MS (2009) Revision of the bee genus *Chlerogella* (Hymenoptera, Halictidae), Part I: Central American species. ZooKeys 23: 47–75. doi: 10.3897/zookeys.23.248

Abstract

The Central American species of the rare bee genus *Chlerogella* Michener (Halictinae: Augochlorini) are revised. Aside from the previously described *Chlerogella elongaticeps* Michener and *C. clidemiae* Engel, five new species are added to the fauna and figured as *C. prolixa* **sp. n.**, *C. fortunaensis* **sp. n.**, *C. kellieae* **sp. n.**, *C. anthonoma* **sp. n.**, and *C. pinocchio* **sp. n.** These species include the first records from Costa Rica (*C. kellieae*, *C. anthonoma*, and *C. pinocchio*) and the first description of the male for *C. elongaticeps*. A dichotomous key to the species is provided.

Keywords

Apoidea, Anthophila, Halictinae, Augochlorini, *Chlerogella*, taxonomy, new species, identification key, Panamá, Costa Rica

Introduction

The bee genus *Chlerogella* Michener is a rarely encountered representative of the halictid tribe Augochlorini. Originally described on the basis of a single female from central Panamá (Michener 1954), further information on the genus was not forthcom-

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ing until Moure and Hurd (1987) recognized that two earlier species described from Peru by Vachal (1901) and Enderlein (1903) also belonged therein. However, like the type species *Chlerogella elongaticeps* Michener, both *C. buyssoni* (Vachal) and *C. nasus* (Enderlein) were known only from their female holotypes. The same was true for the two most recently described species, *C. clidemiae* Engel (2003a) from Panamá and *C. mourella* Engel (2003b) from Ecuador, although the former was captured at flowers of *Clidemia crenulata* Gleason (Melastomataceae), representing the first such record for the genus. Today the genus remains one of the more rare among the Augochlorini and although there are numerous species (Engel, in prep.), only a few are known from significant series of individuals.

Herein I provide a review of those species in Central America, expanding the formerly documented diversity of two species to seven and expanding the generic range into Costa Rica. The extensive South American fauna and a revised concept for the genus will be provided in the second part of this work (Engel, in prep.). Given the rarity with which individuals have been collected and the large regions of suitable habitat between collection localities (Maps 1, 2) further species will undoubtedly be discovered. Most specimens of the genus have been captured in traps and even then only infrequently. It is unclear why individuals should be so seemingly rare and perhaps the eventual elucidation of *Chlerogella* biology will provides answers to this mystery. In the interim it is hoped that these works will bring the genus to the attention of a wider range of melittologists and to highlight what glimpses into its diversity are presently available.

Material and Methods

Material for this first portion of the study consisted of 14 specimens (6♀♀, 8♂♂, despite 15 years of looking for *Chlerogella* in muesums) from the following collections:

AEI American Entomological Institute, Gainesville, Florida, USA.

AMNH Division of Invertebrate Zoology (Entomology), American Museum of Natural History, New York, New York, USA.

INBio Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica.

SEMC Division of Entomology (Snow Entomological Collection), University of Kansas Natural History Museum, Lawrence, Kansas, USA.

Morphological terminology for this study follows that of Michener (1944, 2007) and Engel (2000, 2001) except that the elongate "teeth" of the metatibial spurs are here referred to as "branches" as this term more accurately reflects their shape and the main body of the spur from which the branches arise is termed the "rachis". The abbreviations S and T are used in place of metasomal sternum and tergum, respectively. The format for the descriptions is generally taken from that used elsewhere in Augochlorini (e.g., Engel 2007). Measurements were prepared using an ocular micrometer on an

Olympus SZX-12 stereomicroscope. Head length was calculated by measuring from the vertex to the apex of the clypeus, head width from the maximum outer borders of the compound eyes, intertegular distance from the inner borders of the tegulae, and total body length by measuring the individual lengths of the head, mesosoma, and metasoma and summing the values. A comparison of some measurements of the head and antennae for Central American *Chlerogella* is provided in Table 1. The surface sculpturing was studied through diffused light to minimize metallic reflectance and permit the details to be discerned.

Systematics

Genus *Chlerogella* Michener

Chlerogella elongaticeps Michener

Figs 1–6, 20, 21; Map 1

Chlerogella elongaticeps Michener, 1954: 75. Eickwort, 1969: 444–445; Moure and Hurd, 1987: 218; Engel, 2003a: 1–2; Moure et al., 2007: 794.

Holotype. ♀; Panamá: Coclé [Province], El Valle de Antón, 1 April 1945, C.D. Michener (AMNH).

Additional material. Panamá: 1♂, Panamá [Province], Cerro Campana, 800–860m, 17 July 1978, E.M. Fisher (SEMC).

Table 1. Comparison of head metrics across Central American species of *Chlerogella*; values in millimeters where appropriate; ML vs. MB is the malar length as a function of the number of times the basal mandibular width; the abbreviation F is used for flagellomere and FII vs. FI is the length of the second flagellomere as a function of the number of times the length of the first flagellomere (only meaningful in males where there is significant variation).

Species	Head length	Head width	Malar length	Eye length	Malar-Eye %	ML vs. MB	FII vs. FI
Females (♀)							
C. elongaticeps Michener	2.40	1.50	0.36	1.46	25%	2.0×	n.a.
C. clidemiae Engel	3.04	1.58	1.04	1.52	68%	5.4×	n.a.
C. prolixa, sp. n.	2.93	1.87	0.73	1.63	45%	3.1×	n.a.
C. kellieae, sp. n.	2.83	1.60	0.73	1.60	46%	3.1×	n.a.
Males (♂)							
C. elongaticeps Michener	2.47	1.67	0.33	1.57	21%	1.7×	—
C. prolixa, sp. n.	2.93	1.80	0.73	1.60	46%	3.7×	4.0×
C. fortunaensis, sp. n.	2.76	1.62	0.78	1.40	56%	3.9×	—
C. kellieae, sp. n.	2.80	1.67	0.73	1.52	48%	3.7×	3.2×
C. anthonoma, sp. n.	2.80	1.53	0.83	1.43	58%	4.2×	3.0×
C. pinocchio, sp. n.	2.57	1.40	0.70	1.33	53%	3.5×	2.8×

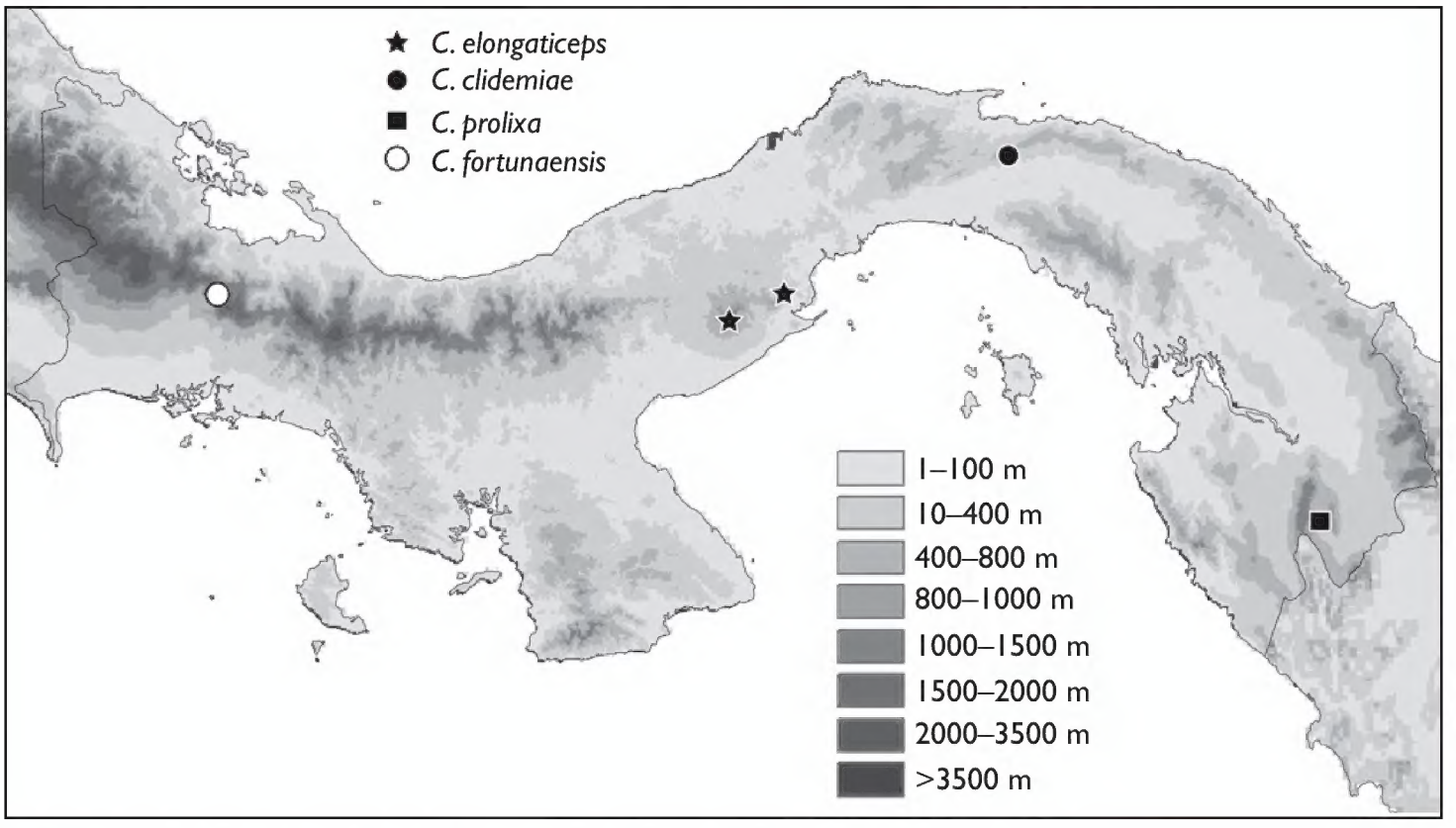
Diagnosis. *Chlerogella elongaticeps* is a distinctive species in that it has an elongate upper surface to the pronotum (medial length nearly two times an ocellar diameter), a relatively short malar space (only 21–25% of the compound eye length: cf. values in table 1) (Figs 2, 3, 5, 6), the form of the male SIV (Fig. 20), and the male genitalia (Fig. 21). The amber mesosoma with a darkened mesoscutum bearing metallic reflections

Figures 1–3. Holotype female of *Chlerogella elongaticeps* Michener. **1** Lateral habitus and view of separately mounted metasoma **2** Lateral aspect of head **3** Facial aspect.

(Figs 1, 4) is similar among Central American species to the female of *C. clidemiae* and the male of *C. anthonoma*.

Description. *Female*: Total body length 8.95 mm [Michener's (1954) value of 7.50 mm was made with the head in repose rather than considering it stretched forward as in the calculation provided here]; forewing length 5.52 mm. Head length 2.40 mm, width 1.50 mm. Base of clypeus at lower tangent of compound eyes. Malar space 25% of compound eye length (malar length 0.36 mm; compound eye length 1.46 mm).

Figures 4–6. Male of *Chlerogella elongaticeps* Michener. **4** Lateral habitus **5** Facial aspect **6** Lateral aspect of head.



Map 1. Collection localities for Panamanian *Chlerogella*.

Upper interorbital distance 0.72 mm; lower interorbital distance 0.54 mm. Upper portion of pronotum elongate, medially about two times ocellar diameter in length; ventral portion of preëpisternal sulcus not broad, similar to scrobal sulcus and upper portion of preëpisternal sulcus; intertegular distance 1.26 mm; mesoscutellum weakly convex, not bigibbous. Basal vein distad cu-a by three times vein width; 1rs-m distad 1m-cu by five times vein width; 2rs-m distad 2m-cu by seven times vein width, 2rs-m gently arcuate; first submarginal cell longer than combined lengths of second and third submarginal cells; second submarginal cell slightly narrowed anteriorly, anterior border of second submarginal cell along Rs about as long as that of third submarginal cell; posterior border of third submarginal cell nearly three times as long as anterior border. Distal hamuli arranged 2-1-2. Inner metatibial spur with three branches (not including apical portion of rachis).

Clypeus and supraclypeal area smooth with weak punctures separated by 1–3 times a puncture width, punctures weaker and sparser medially. Upper half of face with small punctures separated by a puncture width or less, otherwise faintly imbricate; lower half of face sculptured as on supraclypeal area except punctures separated by a puncture width; malar space largely impunctate and smooth; punctures on vertex minute and separated by 1.5–3 times a puncture width; gena smooth, with scattered faint, minute punctures; postgena strongly imbricate and impunctate. Pronotum faintly imbricate; mesoscutum smooth to faintly imbricate with punctures separated by a puncture width except punctures smaller and weaker anteriorly; mesoscutellum sculptured as on mesoscutum although punctures a bit more separated; metanotum faintly imbricate to smooth. Preëpisternum and hypoepimeral area smooth; mesepisternum smooth with minute punctures separated by five or more times a puncture width; metepisternum weakly imbricate. Propodeum weakly imbricate except posterior surface smooth. Metasoma weakly imbricate.

Mandible amber, with reddish apex; labrum and clypeus amber, remainder of head reddish brown with strong copper and weaker metallic green highlights; scape and pedicel amber, remainder of antenna brown. Mesosoma amber except mesoscutum dark reddish brown with metallic green-copper highlights and metanotum and basal margin of basal area (dorsal-facing surface) of propodeum light brown with faint highlights; tegula amber. Wing membranes hyaline; veins amber except pterostigma and Sc+R brown. Legs amber. Metasomal TI–II amber-yellow, with light reddish brown apically, TIII basally amber, apical half reddish brown; TIV–VI dark brown; SI–II amber; SIII–VI brown.

Pubescence golden and generally scattered; laterally on propodeum setae elongate with a few, short, apical branches; scopa composed of moderately-dense elongate plumose setae on metafemur and moderate-length dense palmate setae on metatibia.

Male: As for female with the following modifications: Total body length 9.00 mm; forewing length 5.54 mm. Head length 2.47 mm, width 1.67 mm. Malar space 21% of compound eye length (malar length 0.33 mm; compound eye length 1.57 mm). Upper interorbital distance 0.77 mm, lower interorbital distance 0.43 mm. Intertegular distance 1.17 mm; mesoscutellum very weakly bigibbous. Apical margin of metasomal SIII entire; SIV deeply concave and slightly scalloped, with apicolateral, incurved, thumb-like processes with two, thick, spike-like setae at apex; another weak point one-quarter width bearing a single, thick seta; a very weak point at about one-third width bearing a short peg (Fig. 20); SV entire; SVI emarginate; hidden and fused sterna unknown [specimen had been previously dissected and the sterna were not present in the capsule]; genital capsule as in figure 21.

Amber in malar space near base of mandible (Fig. 6); face above antennae dark brown with metallic copper-green highlights; supraclypeal area, face below antennae, and remainder of malar space reddish brown with metallic copper highlights. Mesoscutum dark brown to dark reddish brown with metallic copper-green highlights; metanotum and basal area of propodeum light brown with metallic copper highlights; metasomal terga amber with light brown near apical margins; sterna amber.

Typical gender pilosity except inner surface of metafemur with several long, apically-branched setae. Metasomal SIII with diffuse, apicolateral areas of long, apically-branched, erect setae; discs of SIV–VI without setal modifications (marginal setal modifications of SIV described above).

Comments. The holotype of *C. elongaticeps* is in moderately good condition (Fig. 1), although the metasoma became detached at some time in the past and an unknown individual glued it to the label, wisely choosing to mount it on its side so that the sterna are easily visible. Areas of the integument have apparently faded over time as the colors have paled by comparison to Michener's description (e.g., he noted "head dull metallic green" and "mesoscutum, which is black with a dark green tint"). The dark metallic green of the head has now largely faded to a deep reddish brown as has the mesoscutum, although areas of the metallic coloration can still be discerned (Fig. 3). It is not uncommon for coloration resulting multilayer reflectors to change when subjected to extreme environmental stress such as long-term UV exposure (Seago et al.

2009). Given that this specimen apparently had most of its original color in the late 1960s when examined by Eickwort (1969: p. 446 he notes the green tints and does not indicate any significant differences from Michener's original account) and has otherwise resided in a darkened museum drawer it is not clear why it should have become so faded. Unfortunately, newer material of *C. elongaticeps* has not appeared aside from a male in relatively poor condition. The male, presumably long-stored in alcohol, has the setae largely matted and the wings crumpled, with the antennae largely missing except for the left scape, pedicel, and first flagellomere (Figs 4–6).

Chlerogella clidemiae Engel

Figs 7–9; Map 1

Chlerogella clidemiae Engel, 2003a: 2. Moure et al., 2007: 794.

Holotype. ♀, Panamá: San Blas, 19km N of El Llano [El Llano is in Panamá Province with the collection locality 19km North and just across the border into San Blas Province], 350m, 31 January 1985, G. de Nevers, on flowers of *Clidemia crenulata* (SEMC).

Diagnosis. *Chlerogella clidemiae* is most similar to *C. elongaticeps* in that both species are largely amber-yellow (Fig. 7). The former differs from the latter most noticeably by the combination of a more elongate head [malar space 68% of compound eye length vs. 25% in *C. elongaticeps*; malar space 5.4 times longer than basal mandibular width vs. twice as long in *C. elongaticeps* (cf. figures 8, 9 vs. 2, 3)], the clypeus below the lower tangent of the compound eyes (Fig. 9), the shorter pronotal upper surface (medially about ocellar diameter in length vs. medially about two ocellar diameters in length in *C. elongaticeps*) the more widely spaced mesoscutal punctation, the light reddish brown coloration with faint coppery highlights on the head and mesoscutum, and the larger number of branches to the metatibial spur (five vs. three in *C. elongaticeps*).

Description. The description of this species was published only recently and given that no further material has become available I have chosen not to repeat that text here. Refer to Engel (2003a) for a complete description of the holotype.

Chlerogella prolixa Engel, sp. n.

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Figs 10–16, 22, 23; Map 1

Holotype. ♀, Panamá: Darien, Cana Biological Station, Serrania de Pirre, 1250m, 7°45′18″N, 77°41′6″W, 7 June 1996, J. Ashe, ex: flight intercept trap (SEMC).

Paratypes. Panamá: 1♀, 2♂♂, Darien, Cana Biological Station, Serrania de Pirre, 1250m, 7°45′18″N, 77°41′6″W, 4 June 1996, J. Ashe, R. Brooks, ex: flight intercept trap (SEMC); 1♂, Darien, Cana Biological Station, Serrania de Pirre,

1380m, 7°45′18″N, 77°41′6″W, 4–7 June 1996, J. Ashe, R. Brooks, ex: flight intercept trap (SEMC).

Diagnosis. Among Central American species *C. prolixa* is noteworthy for the dull, blue-black integument (Figs 10–15) of the head and mesosoma, the widened ventral portion of the preëpisternal sulcus, the off-white clypeal apex in males (Fig. 14), yellow ventrolaterally on the scape in males (Fig. 15), the structure of the male SIV (Fig. 16), and

Figures 7–9. Holotype female of *Chlerogella clidemiae* Engel. **7** Lateral habitus **8** Lateral aspect of head **9** Facial aspect.

the male terminalia (Figs 22, 23). The male is most similar to *C. fortunaensis* but differs by the off-white mandible, labrum, and clypeal apex, largely off-white scape, the presence of an apical fringe on SIII, the structure of SIV (Fig. 16), and the genitalia (Fig. 23).

Description. *Female*: Total body length 9.40 mm; forewing length 6.48 mm. Head length 2.93 mm, width 1.87 mm. Clypeus beginning below lower tangent of compound eyes. Malar space 45% compound eye length (malar length 0.73 mm; compound eye length 1.63 mm). Upper interorbital distance 0.87 mm; lower interorbital distance

Figures 10–12. Holotype female of *Chlerogella prolixa,* sp. n. **10** Lateral habitus **11** Facial aspect **12** Lateral aspect of head.

0.63 mm. Upper portion of pronotum medially depressed, not elongate, medially less than 0.25 times ocellar diameter in length; ventral portion of preëpisternal sulcus distinctly broad dorsally at junction of scrobal sulcus and upper portion of preëpisternal sulcus; intertegular distance 1.60 mm; mesoscutellum weakly convex, not bigibbous. Basal vein distad cu-a by three times vein width; 1rs-m distad 1m-cu by twice vein width; 2rs-m distad 2m-cu by seven times vein width, 2rs-m straight; first submar-

Figures 13–16. Paratype male of *Chlerogella prolixa,* sp. n. **13** Lateral habitus **14** Facial aspect **15** Lateral aspect of head **16** Detail of modifications on metasomal sternum IV.

ginal cell longer than combined lengths of second and third submarginal cells; second submarginal cell not narrowed anteriorly, anterior border of second submarginal cell along Rs slightly longer than that of third submarginal cell; posterior border of third submarginal cell nearly three times longer than anterior border. Distal hamuli arranged 2-1-2. Inner metatibial spur with six branches (not including apical portion of rachis).

Clypeus and supraclypeal area imbricate with weak punctures separated by 1–3 times a puncture width; face with small, contiguous punctures, more widely spaced in malar space; ocellocular area and vertex faintly imbricate with minute punctures separated by 1–5 times a puncture width; gena smooth with minute punctures separated by 1–6 times a puncture width; postgena imbricate and impunctate. Pronotum smooth with minute punctures separated by 1–2 times a puncture width; mesoscutum smooth with minute punctures separated by 1–3 times a puncture width on lateral thirds and along posterior border, medially punctures giving way to imbricate integument; mesoscutellum smooth with minute punctures separated by 1–3 times a puncture width; metanotum smooth with minute punctures separated by a puncture width. Preëpisternum smooth to faintly imbricate with minute punctures separated by 2–3 times a puncture width; mesepisternum imbricate with minute punctures separated by 4–5 times a puncture width, punctures weak; metepisternum faintly imbricate. Propodeum strongly imbricate. Metasoma weakly imbricate.

Mandible dark brown except reddish at apex; labrum black; clypeal apex black, remainder blue-black; remainder of head blue-black. Antenna dark brown except ventral surfaces of flagellomeres III–X brown. Mesosoma blue-black, blue faint in most areas; tegula dark brown; propodeum dark metallic blue dorsally, blue-black laterally. Wing membranes weakly infumate; veins dark brown. Legs dark brown. Metasoma dark brown.

Pubescence gold to off-white except fuscous on mesoscutum, mesoscutellum, metanotum, outer surfaces of protibia and protarsus, outer surfaces of mesotibia and mesotarsus, inner surface of metatibia, metasomal T5–6, and S5–6; black on inner surfaces of tarsi and tibiae.

Male: As described for the female except as follows: Total body length 10.49 mm; forewing length 6.61 mm. Head length 2.93 mm, width 1.80 mm. Malar space 46% compound eye length (malar length 0.73 mm; compound eye length 1.60 mm). Upper interorbital distance 0.76 mm; lower interorbital distance 0.47 mm. First flagellomere about as long as pedicel, about as long as wide; second flagellomere four times length of first flagellomere (Fig. 15); ventral surfaces of second through eleventh flagellomeres densely covered in placoid sensilla, placoid fields disrupted by narrow mediolongitudinal line of fine, minute trichoid sensilla for lengths of flagellomeres V–VIII, at base and apex of flagellomere IV and basal half of flagellomere IX. Intertegular distance 1.37 mm; mesoscutellum bigibbous. Inner metatibial spur serrate. Apical margin of metasomal SIII entire; apical margin of SIV medioapically produced, with concave emargination between setose lobes (Fig. 16), with narrow medio-longitudinal furrow in apical half of disc (Fig. 16), furrow widening apically, basally bordered by short carinae; apical margin of SV minutely emarginate; apical margin of SVI emarginate; terminalia as depicted in figures 22 and 23.

Mandible, labrum, and clypeal apex off-white; small, faint off-white patch on malar space near mandible base. Ventral surface and base of scape pale yellow. Inner surface of protibia, profemur, and inner apex of mesofemur yellow.

Typical gender pilosity except postgena with numerous elongate, sinuate setae, such setae with short apical branches; inner surfaces of trochanters, mesofemur, metacoxa, metatrochanter, and metafemur with elongate, apically-plumose setae, similar setae on inner surface of metatibia except largely simple. Apical margin of metasomal SIII with fringe of moderate-length golden setae; SIV with medioapical pads of short golden setae bordering medial furrow (Fig. 16); SV laterally with diffuse pads of elongate, inwardly-curved setae (Fig. 16).

Etymology. The specific epithet is based on the Latin term *prolixus*, meaning "stretched out long".

Chlerogella fortunaensis Engel, sp. n.

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Figs 17–19; Map 1

Holotype. ♂, Panamá: Fortuna, Chiriquí, 1050m, 8°44′N, 82°15′W, 10–16. VIII.1977 [10–16 August 1977], H. Wolda, at light (SEMC).

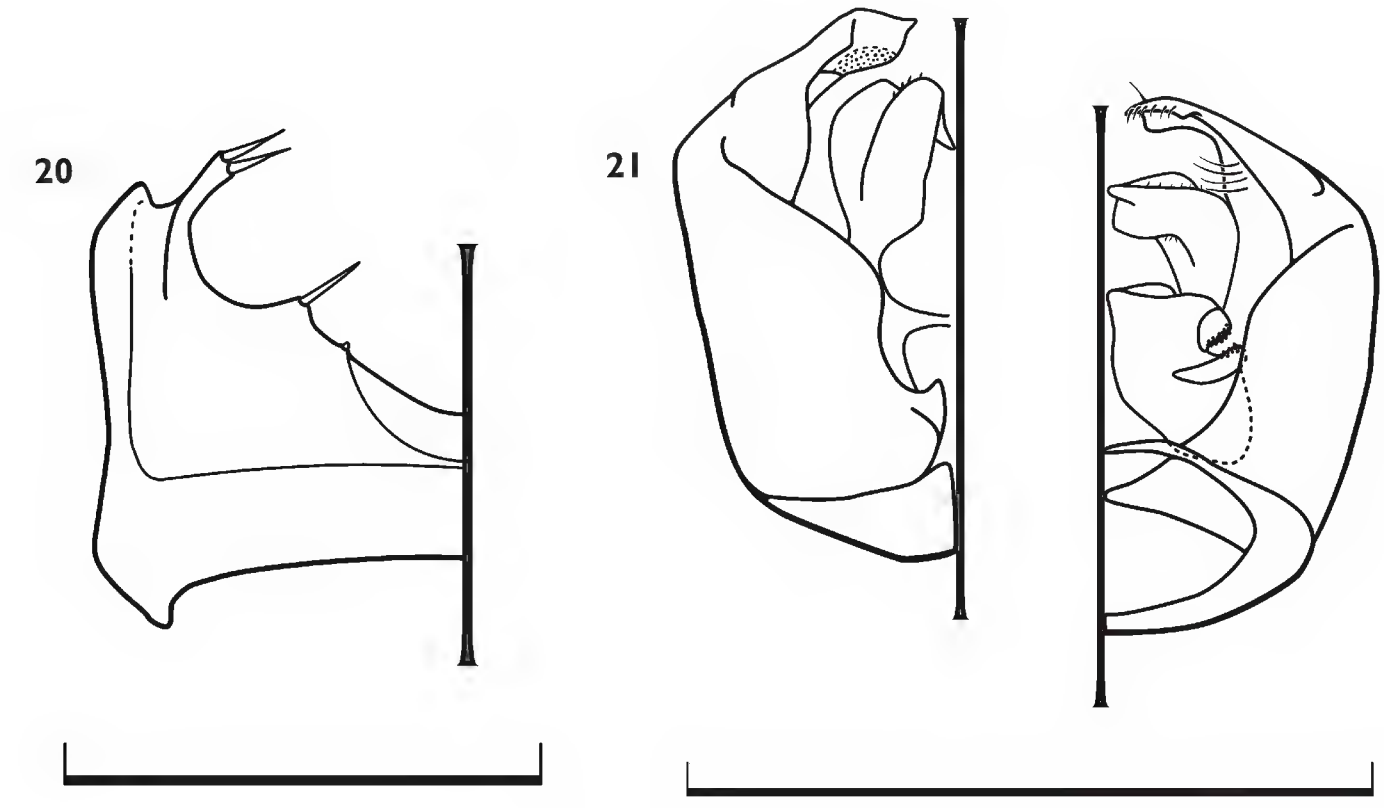
Diagnosis. Among the darker Central American species *C. fortunaensis* can be recognized by the combination of metallic blue integument on the head and mesosoma (Figs 17–19), unmodified sterna III–V, brown clypeal apex and pedicel, and largely brown scape.

Description. *Male*: Total body length 9.36 mm; forewing length 6.0 mm. Head length 2.76 mm, width 1.62 mm. Base of clypeus below lower tangent of compound eyes. Malar space 56% compound eye length (malar length 0.78 mm; compound eye length 1.4 mm). Upper interorbital distance 0.8 mm; lower interorbital distance 0.42 mm. First flagellomere about as long as pedicel, about as long as wide. Intertegular distance 1.28 mm; mesoscutellum bigibbous. Basal vein distad cu-a by three times vein width; 1rs-m distad 1m-cu by three times vein width; 2rs-m distad 2m-cu by seven times vein width, 2rs-m straight; first submarginal cell longer than combined lengths of second and third submarginal cells; second submarginal cell not narrowed anteriorly, anterior border of second submarginal cell along Rs slightly shorter than that of third submarginal cell; posterior border of third submarginal cell approximately twice as long as anterior border. Distal hamuli arranged 2-1-2. Inner metatibial spur serrate. Exposed portion of genitalia (gonostyli and apical halves of penis valves) similar to *C. anthonoma* except apex of valves densely covered with moderate-length thick setae, those more apical slightly longer, dorsally with two thick moderate-length setae reaching over apex.

Clypeus and supraclypeal area faintly imbricate with weak punctures separated by 1–2 times a puncture width; face smooth with minute punctures separated by 1–2 times a puncture width, punctures becoming more widely spaced in ocellocular area and on vertex and gena, separated by 2–5 times a puncture width; postgena imbricate and impunctate. Pronotum smooth; mesoscutum smooth with minute punctures separated by

2–3 times a puncture width except around median line punctures more coarse and separated by 1–2 times a puncture width; mesoscutellum smooth with punctures separated by 1–2 times a puncture width; metanotum smooth with scattered minute punctures;

Figures 17–19. Holotype male of *Chlerogella fortunaensis,* sp. n. **17** Lateral habitus as preserved **18** Facial aspect **19** Lateral aspect of head.



Figures 20–23. Male terminalia for Panamanian *Chlerogella* species (excluding C. fortunaensis, sp. n. which was not dissected owing to condition of the holotype and the unknown male for *C. clidemiae* Engel) **20** *Chlerogella elongaticeps* Michener, sternum IV **21** *C. elongaticeps*, genital capsule (left is dorsal aspect, right is ventral aspect) **22** *C. prolixa,* sp. n., hidden and fused sterna VII and VIII **23** *C. prolixa,* sp. n., genital capsule (left is dorsal aspect, right is ventral aspect). All scale bars = 1.0 mm.

pleura smooth with minute punctures separated by 3–5 times a puncture width except metepisternum impunctate. Propodeum imbricate. Metasoma weakly imbricate.

Mandible amber with reddish apex; labrum amber; clypeal apex brown, remainder of clypeus and head brilliant metallic blue with a few metallic purple highlights; base of scape amber, remainder of scape and pedicel brown, first flagellomere dark brown (remainder of antenna not preserved). Mesosoma brilliant metallic blue with a few metallic purple highlights; tegula brown with a few metallic blue highlights anteriorly. Wing membranes hyaline; veins dark brown. Legs brown to dark brown with metallic blue highlights on coxae, metatrochanter, and metafemur. Metasoma dark brown.

Pubescence generally white except fuscous on metatarsus. Typical pilosity for gender except postgena with scattered elongate, sinuate setae, a few with minute apical branches; ventral surfaces of metafemur and metatibia with widely scattered elongate, sinuate, largely simple setae. Metasoma SIII without apical setal fringe and SIV without medioapical setal pads.

Female: Unknown.

Etymology. The specific epithet is based on the type locality, Fortuna, Panamá.

Comments. This species is based on a poorly-preserved male captured in a trap sampling insects in Chiriquí. The head became detached at some time in the past and was mounted on the block beneath the body. The head is missing the antennae except for the scape, pedicel, and first flagellomere of the left antenna. The body is somewhat covered in fine debris and scales and the apex of the metasoma opened with the apex of the genitalia exposed. Given the fragility of the specimen it was not dissected further but fortunately the male genitalia are sufficiently visible to further confirm the distinctness of the species.

Chlerogella kellieae Engel, sp. n.

urn:lsid:zoobank.org:act:65F1860A-3A61-40C5-93DA-91BF08881783

Figs 24–29, 36, 37; Map 2

Holotype. ♂, Costa Rica: Guanacaste, Cacao Biological Station, 1050m, 10°55′38″N, 85°27′7″W, 10–11 July 2000, J. Ashe, R. Brooks, Z. Falin, ex: flight intercept trap (SEMC).

Paratypes. Costa Rica: 1♀, Est. Carrillo, 700m, P.N. Braulio Carrillo, Prov. S. José, 15–17 February 1993 (INBio); 1♀, Río San Lorenzo, Tierras Morenas, Z.P. Tenorio, Prov. Guanacaste, 1050m, November 1992, G. Rodríguez (INBio).

Diagnosis. *Chlerogella kellieae* can be distinguished by the metallic green color of the head and mesosoma (Figs 24–29), the metasoma that is extensively marked with yellow in the male (Fig. 24) and amber in the female (Fig. 27), the malar space that is slightly less than one-half the compound eye length (table 1), and the structure of the male terminalia (Figs 36, 37).

Description. *Male*: Total body length 8.93 mm; forewing length 6.40 mm. Head length 2.80 mm, width 1.67 mm. Base of clypeus at lower tangent of compound eyes.

Malar space 48% of compound eye length (malar length 0.73 mm; compound eye length 1.52 mm). Upper interorbital distance 0.76 mm; lower interorbital distance 0.40 mm. First flagellomere about as long as pedicel, about as long as wide; second flagellomere 3.2 times length of first flagellomere; ventral surfaces of second through eleventh flagellomeres densely covered in placoid sensilla, placoid fields disrupted by narrow

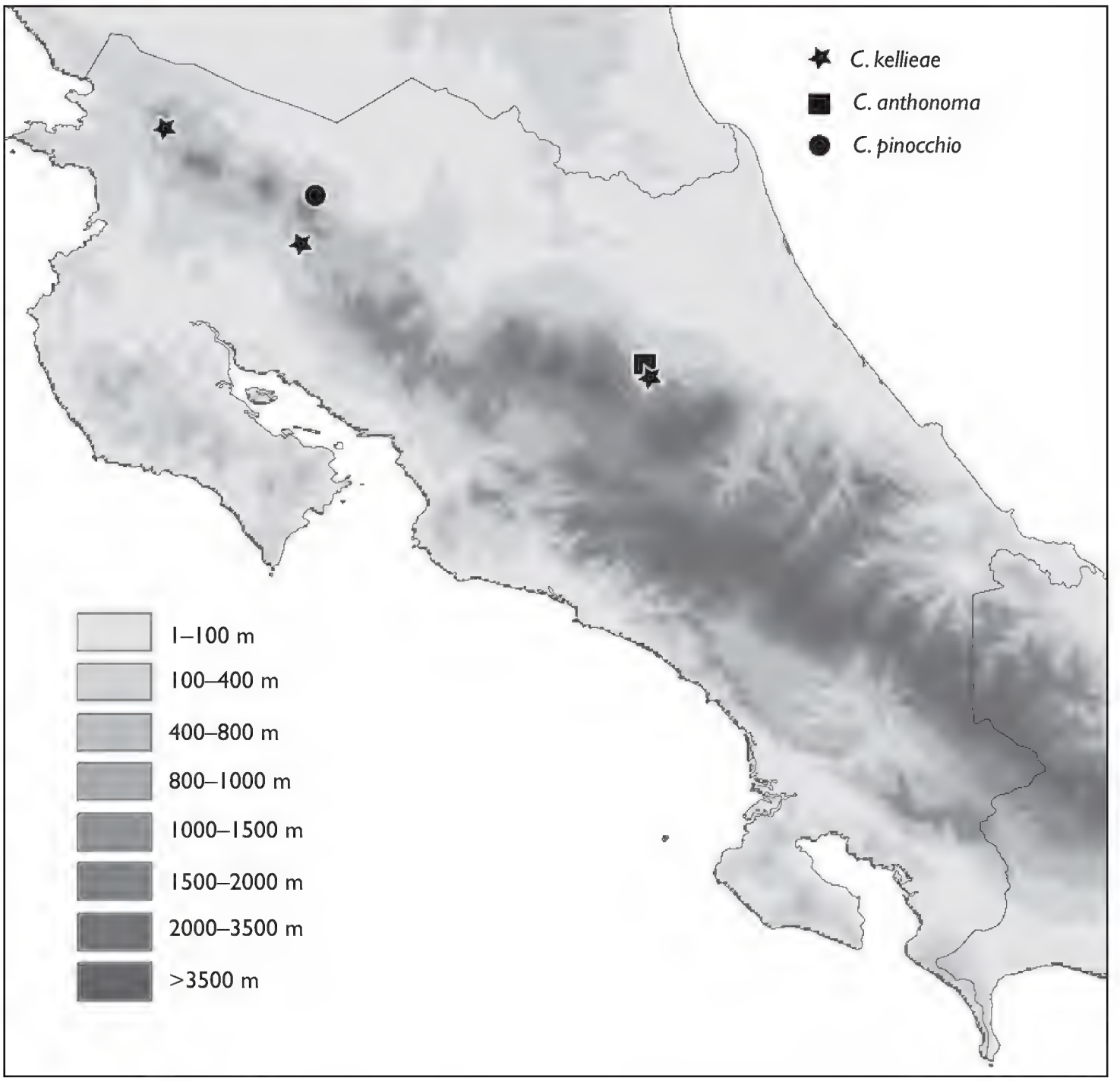
Figures 24–26. Holotype male of *Chlerogella kellieae,* sp. n. **24** Lateral habitus **25** Facial aspect **26** Lateral aspect of head.

mediolongitudinal line of fine, minute trichoid sensilla for lengths of flagellomeres V–VIII, at base and apex of flagellomere IV and basal half of flagellomere IX. Intertegular distance 1.29 mm; mesoscutellum bigibbous. Basal vein distad cu-a by two times vein width; 1rs-m distad 1m-cu by two times veins width; 2rs-m distad 2m-cu by five times vein width, 2rs-m relatively straight; first submarginal cell longer than combined lengths of second and third submarginal cells; second submarginal cell not narrowed anteriorly, anterior border of second submarginal cell along border with Rs about as long as that of third submarginal cell; posterior border of third submarginal cell about twice as long

Figures 27–29. Paratype female of *Chlerogella kellieae,* sp. n. **27** Lateral habitus (note that apparently darker areas on the metasoma are due to discoloration of shriveled internal tissues visible through the somewhat translucent terga, the metasomal coloration is otherwise amber) **28** Lateral aspect of head **29** Facial aspect.

as anterior border. Distal hamuli arranged 2-1-2. Inner metatibial spur serrate. Metasomal sterna III–IV unmodified, with apical margins straight except for a minute median emargination on SIV; apical margin SVI emarginate; terminalia as in figures 36 and 37.

Clypeus and supraclypeal area weakly imbricate, with weak punctures separated by 1–3 times a puncture width. Head above level of antennae smooth with small punctures separated by a puncture width or less, below level of antennae and in malar space with minute punctures separated by 1–3 times a puncture width, integument faintly imbricate; punctures of face becoming more minute and separated by 2–5 times a puncture width in ocellocular area, on vertex and gena; postgena strongly imbricate and impunctate. Pronotum smooth to faintly imbricate. Mesoscutum smooth, with small punctures separated by 1–2.5 times a puncture width, anteriorly punctures become weaker and integument weakly imbricate; mesoscutellum sculptured as on mesoscutum; metanotum smooth with minute punctures separated by 2–3 times a puncture width. Preëpisternum and mesepisternum smooth with minute punctures separated by 5 times a puncture



Map 2. Collection localities for Costa Rican *Chlerogella*.

width or more; metepisternum smooth with minute punctures separated by 3 times a puncture width or more. Propodeum imbricate. Metasoma weakly imbricate.

Mandible, labrum, clypeal apex, and area in malar space bordering mandible yellow; remainder of clypeus dark brown with strong metallic green highlights; remainder of head metallic green with copper highlights. Scape and pedicel yellow, remainder of antenna dark brown. Mesosoma metallic green with copper highlights except pronotal lobe yellow and small amber-brown patch posteriorly on mesepisternum; tegula translucent yellow. Wing membranes lightly infumate; veins brown except Sc+R dark brown. Legs largely yellow with extensive brown on hind legs except metatarsus beyond the metabasitarsus and on outer surfaces of pro- and mesotibiae. Metasoma largely brown with yellow markings laterally and basally and as a thin transverse band on TII–V and laterally and mediodorsally on TI; TVI largely yellow-brown; sterna largely yellow except brown markings apically on SIII–V, faint medially on SI.

Pubescence generally golden except darkly fuscous on inner surface of metabasitarsus; typical gender pilosity except inner surface of metafemur with several long, apically-branched setae; metasomal SIV with diffuse apicolateral areas of appressed, short, inwardly-directed setae, intermingled with longer erect to suberect, simple setae; SV with diffuse apicolateral lines of short, erect to suberect, largely simple setae.

Female: As described for the male except as follows: Total body length 8.89 mm; forewing length 6.33 mm. Head length 2.83 mm, width 1.60 mm. Base of clypeus at lower tangent of compound eyes. Malar space 46% of compound eye length (malar length 0.73 mm; compound eye length 1.60 mm). Upper interorbital distance 0.80 mm; lower interorbital distance 0.53 mm. Antenna not so modified as in male, as in figure 29. Upper portion of pronotum not elongate, medially less than 0.25 times ocellar diameter in length; ventral portion of preëpisternal sulcus not broad, similar to scrobal sulcus and upper portion of preëpisternal sulcus; intertegular distance 1.40 mm; mesoscutellum weakly convex, not bigibbous. Distal hamuli arranged 2-1-2. Inner metatibial spur pectinate, with four or five branches (not including apical portion of rachis).

Mandible brown, with reddish apex; labrum brown; clypeal apex brown, remainder of clypeus brown with strong metallic green-copper highlights; remainder of head dark metallic green with copper highlights. Scape ventrally yellow, dorsally brown, pedicel yellow-brown, remainder of antenna dark brown. Legs largely brown with amber around podite articulations and on tarsi except metabasitarsus. Metasoma amber to reddish amber (note that apparently darker areas in figure 27 are due to discoloration of shriveled internal tissues visible through the somewhat translucent terga).

Etymology. The specific epithet is a matronym honoring my loving and supporting wife, Mrs. Kellie K. Magill Engel.

Comments. One of the females attributed to this species was captured near the type locality for *C. anthonoma* (*vide infra*) and at some distance from the Guanacaste records for the holotype and other female paratype. Nonetheless, the San José Province female has the same proportions as the Guanacaste female, same sculpturing, same coloration, and similar wing venation as to the holotype and other paratype. They are clearly conspecific and I feel confident that the San José specimen is not the unknown

female for *C. anthonoma* which is clearly a separate species as evidenced by its wing venation, head proportions, and male terminalia.

***Chlerogella anthonoma* Engel, sp. n.**
urn:lsid:zoobank.org:act:783629FA-13EA-475A-80D2-E8DFD90375C9
Figs 30–32, 38, 39; Map 2

Holotype. ♂, Costa Rica: San José, Braulia Carville [sic] N.P., 400m, 10–11 April 1983, H. Goulet, tropical rainforest (AEI).

Diagnosis. This species is related apparently to *C. kellieae* described above (*vide supra*) as evidenced by the similar overall structure, body proportions, and genitalia. *Chlerogella anthonoma* can be distinguished by the combination of an amber mesosoma with only the mesoscutum dark metallic green (resembling in this respect *C. elongaticeps*) (Fig. 30), the clypeus more extensively marked with amber (cf. Figs 25 vs. 31), the slightly more elongate head (Figs 31, 32), the entirely golden setae of the inner surface of the metabasitarsus, the entirely amber metasoma, the greatly reduced second submarginal cell, and the structure of the terminalia (Figs 38, 39).

Description. *Male*: Total body length 8.36 mm; forewing length 5.68 mm. Head length 2.80 mm, width 1.53 mm. Base of clypeus at lower tangent of compound eyes. Malar space 58% of compound eye length (malar length 0.83 mm; compound eye length 1.43 mm). Upper interorbital distance 0.73 mm; lower interorbital distance 0.30 mm. First flagellomere about as long as pedicel, about as long as wide; second flagellomere three times length of first flagellomere; ventral surfaces of second through eleventh flagellomeres densely covered in placoid sensilla, placoid fields disrupted by mediolongitudinal line of fine, minute trichoid sensilla for lengths of flagellomeres V–VIII, those on flagellomeres V and VI medially constricted, and at base and apex of flagellomere IV. Intertegular distance 1.17 mm; mesoscutellum weakly bigibbous. Basal vein distad cu-a by two times vein width; 1rs-m distad 1m-cu by two times veins width; 2rs-m distad 2m-cu by seven times vein width, 2rs-m relatively straight; first submarginal cell longer than combined lengths of second and third submarginal cells; second submarginal cell narrowed anteriorly, anterior border of second submarginal cell along border with Rs about one-quarter that of third submarginal cell; posterior border of third submarginal cell about 1.3 times as long as anterior border. Distal hamuli arranged 2-1-2. Inner metatibial spur serrate. Metasomal sterna III–IV unmodified, with apical margins straight; apical margin SVI emarginate; terminalia as in figures 38 and 39.

Clypeus and supraclypeal area faintly imbricate, with weak punctures separated by 1–3 times a puncture width, more sparse medially. Head above level of antennae smooth with small punctures separated by a puncture width or less, below level of antennae and in malar space with minute punctures separated by 1–3 times a puncture width, integument faintly imbricate; punctures of face becoming more minute and separated by 1–3 times a puncture width in ocellocular area, on vertex and gena; postgena strongly imbricate and impunctate. Pronotum smooth to faintly imbricate. Mes-

oscutum smooth, with minute punctures separated by 2–4 times a puncture width, anteriorly punctures become weaker and integument weakly imbricate; mesoscutellum sculptured as on mesoscutum; metanotum smooth with minute punctures separated by 2–5 times a puncture width. Pleura smooth with minute punctures separated by five times a puncture width or more. Propodeum imbricate. Metasoma weakly imbricate.

Mandible, labrum, clypeal apex, and area in malar space bordering mandible amber; apical third of clypeus amber, remainder dark brown with strong metallic green highlights; remainder of head metallic green with copper highlights, blending to a bluish cast on vertex. Scape and pedicel yellow, remainder of antenna dark brown. Mesosoma amber except mesoscutum metallic green with copper highlights. Wing

Figures 30–32. Holotype male of *Chlerogella anthonoma,* sp. n. **30** Lateral habitus **31** Facial aspect **32** Lateral aspect of head.

membranes lightly infumate; veins brown except Sc+R dark brown. Legs amber. Metasoma amber, with thin transverse brands of amber-brown apically on TI–III.

Pubescence golden; typical gender pilosity except postgena with numerous elongate setae, such setae with a few short apical branches; inner surface of metafemur with several long, apically-branched setae, similar setae on inner surface of metatibia except largely simple; metasomal sterna with scattered, short, suberect to erect, simple setae, setae more numerous apicolaterally on SIV and SV.

Female: Unknown.

Etymology. The specific epithet is the Greek term *anthonomos*, meaning "feeding on flowers".

***Chlerogella pinocchio* Engel, sp. n.**

urn:lsid:zoobank.org:act:97D3CBB5-A234-4A98-892C-11A24912CB70

Figs 33–35, 40, 41; Map 2

Holotype. ♂, Costa Rica: Prov. Alajuela, Est. Pilón [Estación Biológica El Pilón], 700m, 16 July 2004, J. Azofeifa, Ip. Luz Mercurio, Zuampo (INBio).

Diagnosis. Among darker species from Central America, *C. pinocchio* can be distinguished by the metallic dark hunter green integument of the head and mesosoma (Figs 33–35) and the combination of unmodified metasomal sterna III–V with an entirely yellow scape and pedicel, pale yellow clypeal apex, and yellow protibia and tarsi (except metabasitarsus largely brown).

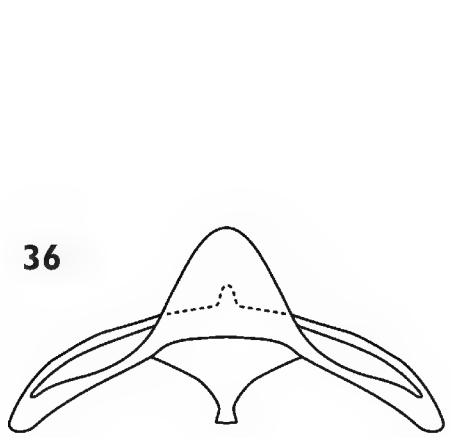
Description. *Male*: Total body length 8.37 mm; forewing length 5.24 mm. Head length 2.57 mm, width 1.40 mm. Base of clypeus below lower tangent of compound eyes. Malar space 53% compound eye length (malar length 0.70 mm; compound eye length 1.33 mm). Upper interorbital distance 0.70 mm; lower interorbital distance 0.33 mm. First flagellomere about as long as pedicel, about as long as wide; second flagellomere 2.8 times length of first flagellomere; ventral surfaces of second through eleventh flagellomeres densely covered in placoid sensilla, placoid fields disrupted by relatively broad mediolongitudinal line of fine, minute trichoid sensilla for lengths of flagellomeres V–IX, at base and apex of flagellomere IV and basal half of flagellomere X. Intertegular distance 1.0 mm; mesoscutellum bigibbous. Basal vein distad cu-a by three times vein width; 1rs-m distad 1m-cu by four times vein width; 2rs-m distad 2m-cu by six times vein width, 2rs-m weakly and gently arcuate; first submarginal cell longer than combined lengths of second and third submarginal cells; second submarginal cell not narrowed anteriorly, anterior border of second submarginal cell along Rs slightly longer than that of third submarginal cell; posterior border of third submarginal cell about 2.5 times longer than anterior border. Distal hamuli arranged 2-1-2. Inner metatibial spur serrate. Apical margins of metasomal SIII–V entire; apical margin of SVI emarginate; terminalia as depicted in figures 40 and 41.

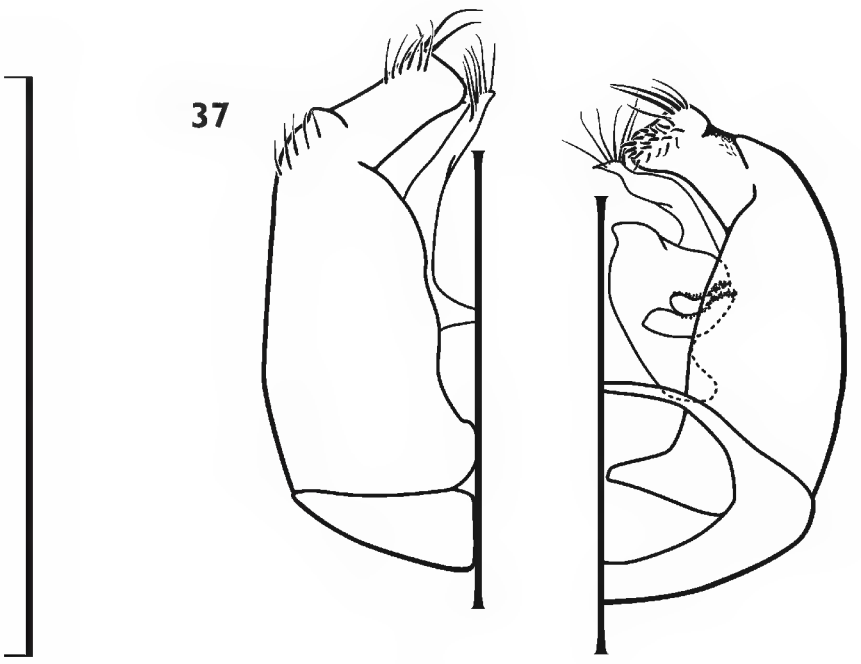
Clypeus and supraclypeal area weakly imbricate with weak punctures separated by 1–3.5 times a puncture width; face smooth with small punctures separated by a puncture width, such punctures more widely spaced in malar space, approximately

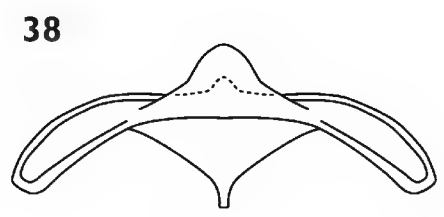
1–2.5 times a puncture width, integument between faintly imbricate; ocellocular area and vertex smooth with even more minute punctures separated by 2–5 times a puncture width; gena smooth with minute punctures separated by 2–6 times a puncture width; postgena imbricate and impunctate. Pronotum smooth with minute punctures separated by 2–5 times a puncture width; mesoscutum smooth with minute punctures separated by 2–5 times a puncture width; mesoscutellum and metanotum sculptured as on mesoscutum. Preëpisternum and mesepisternum smooth with minute punctures separated by 3–6 times a puncture width; metepisternum faintly imbricate. Propodeum strongly imbricate. Metasoma weakly imbricate.

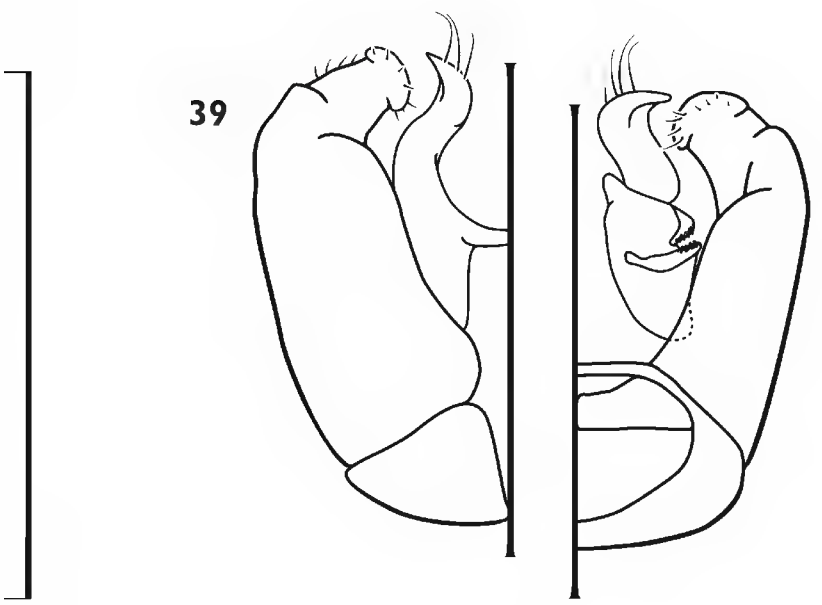
Mandible, labrum, and clypeal apex pale yellow; remainder of clypeus dark brown with metallic green highlights; remainder of head metallic green, turning slightly blu-

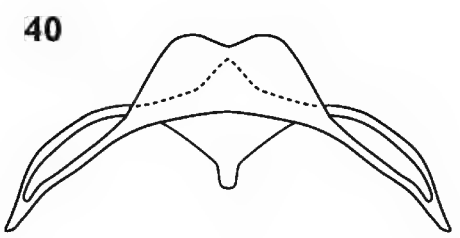
Figures 33–35. Holotype male of *Chlerogella pinocchio,* sp. n. **33** Lateral habitus **34** Facial aspect **35** Lateral aspect of head.

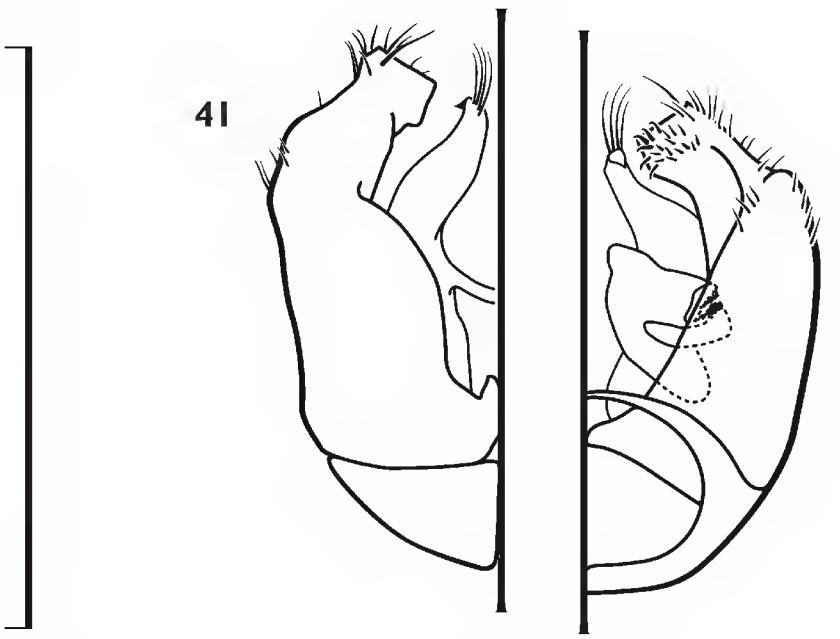












Figures 36–41. Male terminalia for Costa Rican *Chlerogella* species **36** *Chlerogella kellieae,* sp. n., hidden and fused sterna VII and VIII **37** *C. kellieae,* sp. n., genital capsule (left is dorsal aspect, right is ventral aspect) **38** *C. anthonoma,* sp. n., hidden and fused sterna VII and VIII **39** *C. anthonoma,* sp. n., genital capsule (left is dorsal aspect, right is ventral aspect) **40** *C. pinocchio,* sp. n., hidden and fused sterna VII and VIII **41** *C. pinocchio,* sp. n., genital capsule (left is dorsal aspect, right is ventral aspect). All scale bars = 1.0 mm.

ish on vertex and gena; scape and pedicel yellow, flagellum dark brown. Mesosoma dark metallic hunter green; tegula translucent light brown. Wing membranes hyaline; veins brown except Sc+R darker. Legs brown to dark brown except protibia and tarsi (excluding large basal portion of metabasitarsus) yellow, with light brown to yellowish brown areas around podite articulations. Metasoma brown, blending gradually to dark brown by apex; metasomal T1 with small medial yellowish brown spot.

Pubescence generally golden; typical gender pilosity except postgena with numerous elongate setae, such setae with a few short apical branches; inner surfaces of trochanters, mesofemur, metacoxa, metatrochanter, and metafemur with elongate setae, such setae apically with a few short branches; similar setae on inner surface of metatibia except largely simple and of moderate-length. Metasomal sternal discs with sparsely scattered, short, simple, erect setae; apical margin of metasomal SIII with diffuse line of moderate-length, apically-curved setae, such setae slightly more numerous and longer laterally; SIV with apicolateral areas of diffuse short, appressed, inward-directed setae; SV without setal modifications.

Female: Unknown.

Etymology. The specific epithet is a noun in apposition and refers to the fictional wooden doll, Pinocchio, famed for his inveracity and impudence and whose nose grew with each falsehood (Collodi 1883). The name alludes to the elongate rostrum that is shared between this species and its namesake.

Comments. The head of the holotype, and only known specimen, is detached and was mounted by someone in the past on a small point beneath the body. Otherwise the specimen is in excellent condition.

Key to Central American species of *Chlerogella*

Males remain unknown for *C. clidemiae* and females for *C. fortunaensis*, *C. anthonoma*, and *C. pinocchio*.

1. Females **2**
– Males **5**
2(1). Metasoma with at least TI–II amber-yellow (Figs 1, 7, 27); ventral portion of preëpisternal sulcus as wide as scrobal sulcus and upper portion of preëpisternal sulcus **3**
– Metasoma with all terga dark brown (Fig. 10); ventral portion of preëpisternal sulcus distinctly broad dorsally at junction of scrobal sulcus and upper portion of preëpisternal sulcus (Panamá) ..... ***C. prolixa*, sp. n.**
3(2). Pleura and legs amber-yellow (Figs 1, 7); clypeus largely light reddish brown or extensively marked with amber-yellow (Figs 3, 9) **4**
– Pleura and legs largely brown with strong metallic copper highlights (Fig. 27); clypeus dark brown with strong metallic copper highlights, exceedingly narrow transverse band of lighter integument at extreme apex (Fig. 29) (Costa Rica) ..... ***C. kellieae*, sp. n.**

4(3). Malar space 25% of compound eye length, length about twice basal mandibular width (Figs 2, 3); clypeus at lower tangent of compound eyes; mesoscutum dark brown with strong metallic green-copper highlights; inner metatibial spur with three branches, excluding apical portion of rachis; mesoscutum with punctures separated by a puncture width or frequently less; upper pronotal surface expanded, about two ocellar diameters in medial length (Panamá) ..... ***C. elongaticeps*** **Michener**

– Malar space 68% of compound eye length, length more than five times basal mandibular width (Figs 8, 9); clypeus below lower tangent of compound eyes; mesoscutum light reddish brown with faint copper highlights; inner metatibial spur with five branches, excluding apical portion of rachis; mesoscutum with punctures separated by 1–2 times a puncture width; pronotal postero-dorsal surface not expanded, at most a single ocellar diameter in medial length (Panamá) ..... ***C. clidemiae*** **Engel**

5(1). Metasoma entirely dark brown, without amber coloration (Figs 13, 17, 33) **6**

– Metasoma marked with amber-yellow or entirely amber (Figs 4, 24, 30).... **8**

6(5). Metasomal SIV unmodified, apical margin straight, medial furrow and setal pads absent; integument of head and mesosoma dark metallic blue or green 7

– Metasomal SIV medioapically produced and emarginate, with medial longitudinal furrow bordered by inward-directed setal pads (Fig. 16); integument of head (Fig. 14) and mesosoma blue-black (Panamá)..... ***C. prolixa,*** **sp. n.**

7(6). Integument of head and mesosoma metallic green (Figs 33, 34); scape and pedicel entirely yellow; clypeal apex pale yellow (Fig. 34); legs brown to dark brown (except protibia and tarsi, excluding large portion of metabasitarsus, yellow) with light brown to yellowish brown areas around podite articulations (Costa Rica) .....***C. pinocchio,*** **sp. n.**

– Integument of head and mesosoma dark metallic blue with purple highlights (Figs 17, 18); scape and pedicel brown except extreme proximal end of scape a little yellow; clypeal apex brown (Fig. 18); legs entirely brown to dark brown (Panamá) ..... ***C. fortunaensis,*** **sp. n.**

8(5). Malar space more than 50% of compound eye length (Figs 25, 26, 31, 32).....**9**

– Malar space less than 25% of compound eye length (Figs 5, 6) (Panamá) ....***C. elongaticeps*** **Michener**

9(8). Metasoma entirely amber (Fig. 30); pleura largely amber; setae on inner surface of metabasitarsus golden; second submarginal cell very narrow, anterior border along Rs less than one-third length of anterior border of third submarginal cell along Rs (Costa Rica)..... ***C. anthonoma,*** **sp. n.**

– Metasomal terga largely brown, marked with yellow on TI and laterally-basally on terga, sterna almost entirely yellow (Fig. 24); pleura metallic copper-green; setae on inner surface of metabasitarsus dark fuscous; second submarginal cell normally rectangular, anterior border along Rs approximately equal in length to anterior border of third submarginal cell along Rs (Costa Rica) .....***C. kellieae,*** **sp. n.**

Acknowledgements

The author is grateful to the following curators for providing material under their stewardship and for their gracious patience during the long gestation of this study: J.G. Rozen, Jr. (AMNH), Carolina Godoy (INBio: via T.L. Griswold, Bee Biology and Systematics Laboratory, Utah State University), and D.B. Wahl (AEI). Locality data was in some cases retroactively georeferenced by I.A. Hinojosa-Díaz who, along with M. Papeş, produced the maps presented herein. Photomicrographs were prepared by the author while the line drawings were executed by S.L. Taliaferro, supported by the Engel Illustration Fund of the University of Kansas College of Liberal Arts and Sciences. I am grateful to two reviewers for their comments on the manuscript. Partial financial support was provided by U.S. National Science Foundation grants DBI-0096905, EF-0341724, and DEB-0542909 (all to M.S.E.). This contribution is dedicated to the late G.C. Eickwort (1940–1994), world's authority on Augochlorini and who, as graduate mentor, introduced the author to the systematics of these wonderful bees in 1993. This is a contribution of the Division of Entomology, University of Kansas Natural History Museum.

References

Collodi [Lorenzini] C (1883) Le Avventure di Pinocchio. Felice Paggi, Florence, 236+iv pp. [Originally appearing in the serial *Il Giornale per i bambini* from 1881–1883 under the titles *La storia di un burattino* and *Le avventure di Pinocchio*].

Eickwort GC (1969) A comparative morphological study and generic revision of the augochlorine bees (Hymenoptera: Halictidae). University of Kansas Science Bulletin 48(13): 325–524.

Enderlein G (1903) Drei neue Bienen mit rüsselartiger Verlängerung des Kopfes. Berliner Entomologische Zeitschrift 48(1–2): 35–40.

Engel MS (2000) Classification of the bee tribe Augochlorini (Hymenoptera: Halictidae). Bulletin of the American Museum of Natural History 250: 1–89.

Engel MS (2001) A monograph of the Baltic amber bees and evolution of the Apoidea (Hymenoptera). Bulletin of the American Museum of Natural History 259: 1–192.

Engel MS (2003a) A new species of the bee genus *Chlerogella* from Panama (Hymenoptera: Halictidae). Zootaxa 286: 1–4.

Engel MS (2003b) A new bee of the genus *Chlerogella* from Ecuador (Hymenoptera, Halictidae). In: Melo GAR, Alves dos Santos I (Eds) Apoidea: Neotropica: Homenagem aos 90 Anos de Jesus Santiago Moure. Editora UNESC [Universidade do Extremo Sul Catarinense], Criciúma, 135–137 [total volume pages xvi+320 pp.].

Engel MS (2007) Two new augochlorine bees from Ecuador (Hymenoptera: Halictidae). Acta Entomologica Slovenica 15(1): 21–29.

Michener CD (1944) Comparative external morphology, phylogeny, and a classification of the bees (Hymenoptera). Bulletin of the American Museum of Natural History 82(6): 151–326.

Michener CD (1954) Bees of Panamá. Bulletin of the American Museum of Natural History 104(1): 1–176.

Michener CD (2007) The Bees of the World [2nd Edition]. Johns Hopkins University Press, Baltimore, xvi+[i]+953 pp.

Moure JS, Hurd PD, Jr (1987) An Annotated Catalog of the Halictid Bees of the Western Hemisphere (Hymenoptera: Halictidae). Smithsonian Institution Press, Washington, D.C., vii+405 pp.

Moure JS, Urban D, Melo GAR (2007) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region. Sociedade Brasileira de Entomologia, Curitiba, xiv+1058 pp.

Seago AE, Brady P, Vigneron J-P, Schultz TD (2009) Gold bugs and beyond: A review of iridescence and structural colour mechanisms in beetles (Coleoptera). Journal of the Royal Society Interface 6(Supplement 2): 165–184. doi: 10.1098/rsif.2008.0354.focus

Vachal J (1901) Contributions hyménoptériques. V.– Hymenoptera mellifera americana nova. Annales de la Société Entomologique de France 70: 77–82.